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TITLE **Phased Array Communication Antenna System for
Fairlines Hardware Interface Control Document**

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ABSTRACT

This document defines the hardware interfaces for the Phased Array Communication Antenna System for Fairlines. Connectivity and the electrical characteristics of the interfaces between the system line replaceable units (LRUs) are documented.

KEY WORDS

Airplane
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Television



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ACRONYMS AND ABBREVIATIONS

| | |
|----------|-----------------------------------|
| AC | Alternating Current |
| ARINC | Aeronautical Radio, Inc. |
| AWG | American Wire Gauge |
| BSS | Broadcast Satellite Service |
| dB | Decibel |
| DC | Direct Current |
| EIA | Electronic Industries Association |
| GHz | Gigahertz |
| HP | Horizontal polarization |
| ICD | Interface Control Document |
| LHCP | Left-hand circular polarization |
| LNB | Low Noise Block |
| LP | Linear polarization |
| LPC | Linear Polarization Converter |
| LRU | Line Replaceable Unit |
| MHz | Megahertz |
| RF | Radio Frequency |
| RHCP | Right-hand circular polarization |
| RX | Receive |
| S | Source |
| TX | Transmit |
| VP | Vertical polarization |
| Ω | Ohms |



1. GENERAL

This document applies to the phased array communication antenna system hardware interfaces.

1.1 Scope and Purpose

This interface control document (ICD) documents the connectivity and electrical characteristics of the interfaces between system line replaceable units (LRUs). The ICD content was developed to control the system inter-LRU electrical interfaces. The ICD information represents a design implementation that complies with the Phased Array Communication Antenna System for Fairlines Requirements Document (D909-80003-1). The system external interfaces (included for reference in section 4) and the physical/mechanical interfaces (size, weight, center of gravity, and mounting provisions) are controlled by the Phased Array Communication Antenna System for Fairlines Requirements Document.

1.2 Reference Documentation

| <u>Document Number</u> | <u>Title</u> |
|------------------------|---|
| D909-80003-1 | Phased Array Communication Antenna System for Fairlines Requirements Document |
| S909-32005 | Specification Control Drawing for Low-Noise Block/Down Converter |
| EIA Standard RS-232-C | Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange |
| EIA Standard RS-422 | Electrical Characteristics of Balanced Voltage Digital Interface Circuits |
| EIA Standard RS-485 | Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems |



2. SYSTEM INTERFACE INTERCONNECT DIAGRAM

An interconnect diagram is provided to show the system level connectivity for signals, power, and grounding. System LRUs are represented by solid lined boxes and external items are shown as dash lined boxes. Electrical and signal characteristics for system internal inter-LRU connections are further defined in section 3 of the ICD. System external interfaces are further defined in section 4 of the ICD.

Figure 2-1 shows the system interface connectivity including LRU and signal name identification, connector and pin definition, wire gauge (AWG), and system grounding.

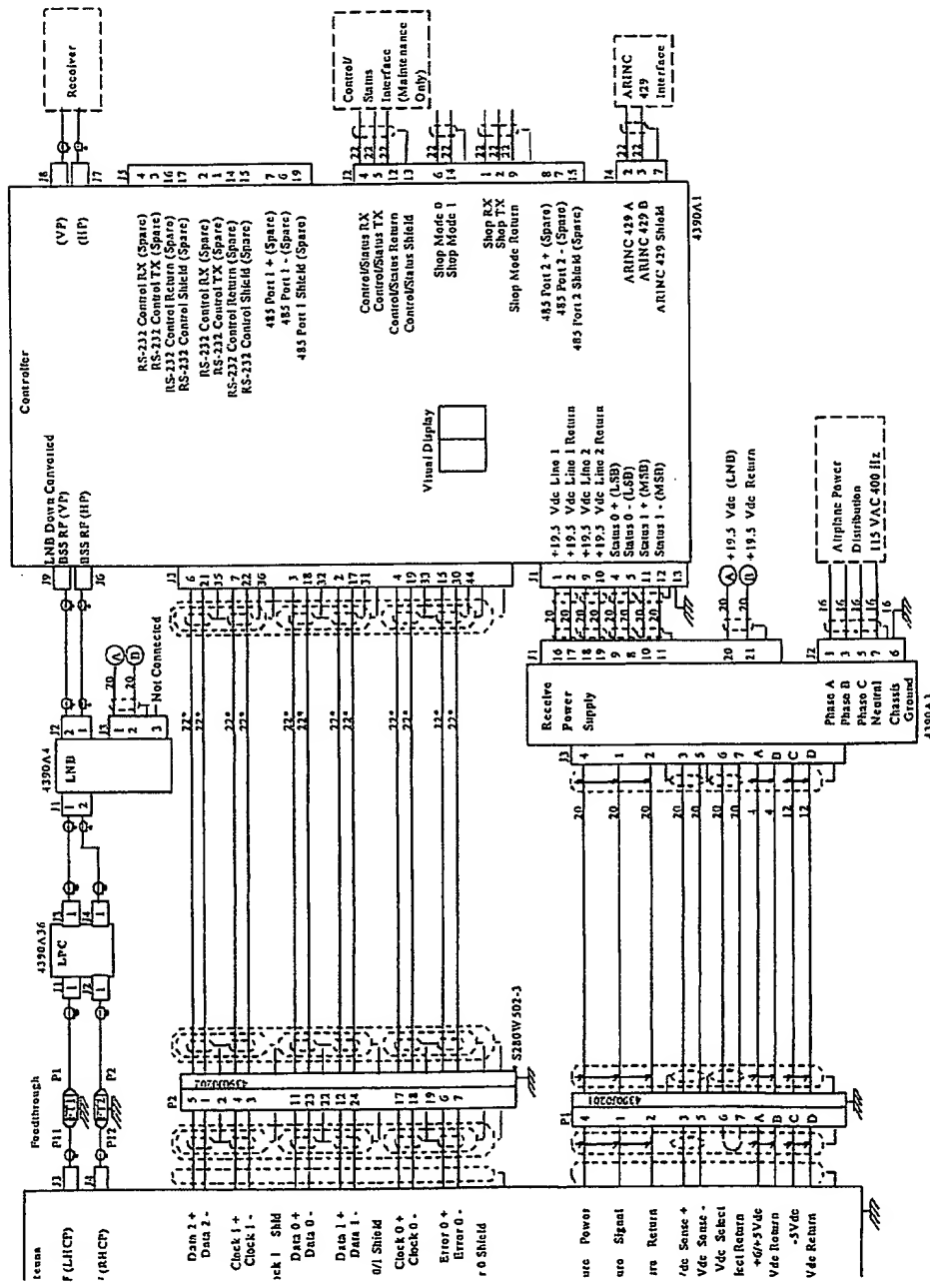


FIGURE 2-1 SYSTEM INTERFACE INTERCONNECT DIAGRAM - FAIRLINES CONFIGURATION



3. INTER-LRU CONNECTIVITY

The signal characteristics for the dual-polarization receive system inter-LRU connections are contained in the sections identified on Figure 3-1.

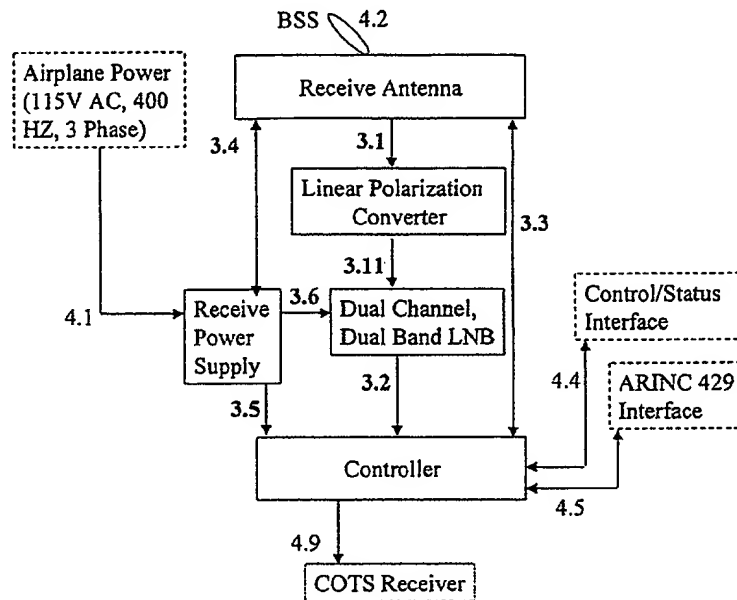


FIGURE 3-1 FAIRLINES SYSTEM INTER-LRU INTERFACE SECTIONS

Note that the "S" columns in the tables that follow stand for "Source" and a "✓" means that the adjacent LRU is the signal source for the associated signal identified by the "Signal Name".



The LRU connectors are as identified in Table 3-1.

TABLE 3-1 LRU CONNECTORS

| 4390A1 Controller | |
|--|--|
| J1 | S906-70293-291 D-Sub DA15 (Pins) |
| J2 | S906-70293-290 D-Sub DA15 (Sockets) |
| J3 | S906-70293-289 D-Sub DB44 (Pins) |
| J4 | S906-70293-293 D-Sub DE9 (Sockets) |
| J5 | S906-70293-292 D-Sub DB25 (Sockets) |
| J6 | TNC (Jack) per MIL-STD-348 (Keyed@162°)* |
| J7 | TNC (Jack) per MIL-STD-348 (Keyed@42°)* |
| J8 | TNC (Jack) per MIL-STD-348 (Keyed@102°)* |
| J9 | TNC (Jack) per MIL-STD-348 (Keyed@222°)* |
| *Four gang keyed TNC connectors P/N K-4985 (Kings Electronics Co.) | |

| 4390FT1 and FT2 Feedthrough | |
|-----------------------------|---|
| | Kings Bulkhead Hermetic Seal 879-13-3 or equivalent |

| 4390A36 Linear Polarization Converter | |
|---------------------------------------|--|
| J1 | SMA (Jack w/socket contact) per MIL-STD-348 (input LHCP) |
| J2 | SMA (Jack w/socket contact) per MIL-STD-348 (input RHCP) |
| J3 | SMA (Jack w/socket contact) per MIL-STD-348 (output VP) |
| J4 | SMA (Jack w/socket contact) per MIL-STD-348 (output HP) |

| 4390A2 Antenna | |
|----------------|---|
| P1 | S909-13056-002 (AE3569W25-11P) |
| P2 | BACC63BP16C24PN |
| J3 | SMA (Jack w/socket contact) per MIL-STD-348 |
| J4 | SMA (Jack w/socket contact) per MIL-STD-348 |

| 4390A3 Power Supply | |
|---------------------|--------------------------------|
| J1 | BACC63CC24-43SN |
| J2 | BACC63CC14-7PN |
| J3 | S909-13056-001 (AE3560W25-11S) |

| 4390A4 Low Noise Block-Downconverter | |
|---|------------------------|
| J1 | SMA per MIL-C-39012/60 |
| J2 | TNC per MIL-C-39012/32 |
| J3 | BACC63BV8F3PN |
| Note: SMA and TNC connectors are configured per the LNB SCD (S909-32005). | |



The system RF allocations are as identified in Figure 3-2.

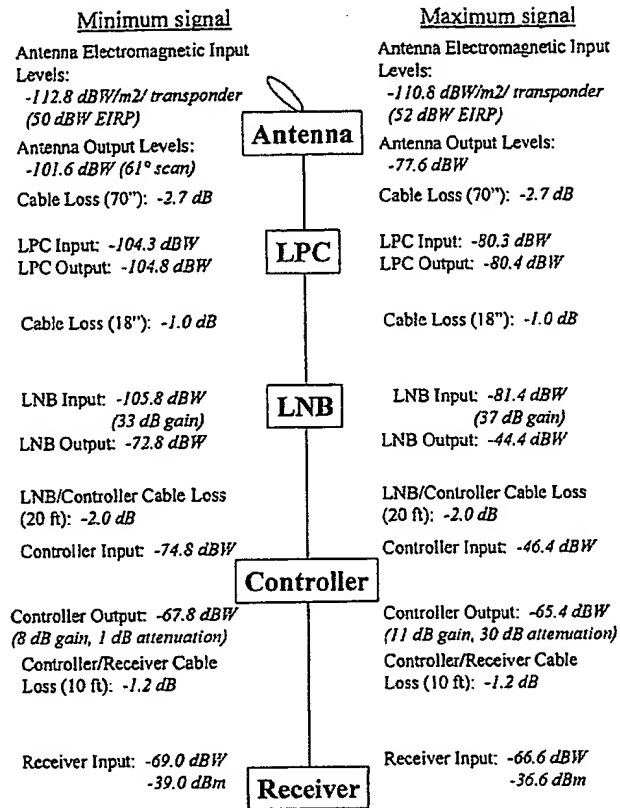


FIGURE 3-2 FAIRLINES SYSTEM RF ALLOCATIONS



3.1 Receive Antenna/LPC Interface

The receive antenna/LPC interface signal characteristics are defined in Table 3.1-1.

TABLE 3.1-1 RECEIVE ANTENNA/LNB SIGNAL CHARACTERISTICS

| Receive Antenna (4390A2) Connector | S | Signal Name | Signal Characteristics | S | LPC (4390A36) Connector/ Pin Number |
|------------------------------------|---|---------------|--|---|-------------------------------------|
| J3 (SMA) | √ | BSS RF (LHCP) | RF Frequency Range: 11.7 to 12.7 GHz Signal Level: per figure 3-2 RF Impedance: 50 Ω | | J1-1 (SMA) |
| J4 (SMA) | √ | BSS RF (RHCP) | (Same as BSS RF (LHCP)) | | J2-1 (SMA) |

Note that each receive antenna to LPC cable connection includes a feedthrough shown on Figure 2-1. LHCP and RHCP cables are identical length (+/- 5 millimeter). Total length from antenna to LPC is 70" ± 1".

3.2 LNB/Controller Interface

The LNB/controller interface signal characteristics are defined in Table 3.2-1.

TABLE 3.2-1 LNB/CONTROLLER SIGNAL CHARACTERISTICS

| LNB (4390A4) Connector/ Pin Number | S | Signal Name | Signal Characteristics | S | Controller (4390A1) Connector |
|------------------------------------|---|-------------------------------|--|---|-------------------------------|
| J2-2 (TNC) | √ | LNB Downconverted BSS RF (VP) | RF Frequency Range: 950 to 1450 MHz Signal Level: per figure 3-2 RF Impedance: 50 Ω | | J9 (TNC) |
| | | LNB Band Select (VP) | Voltage: 10.0 to 12.0 Vdc: Convert 11.7-12.2 GHz Band 13.0 to 15.0 Vdc: Convert 12.2-12.7 GHz Band Current: ≤ 50 mA | √ | |
| J2-1 (TNC) | √ | LNB Downconverted BSS RF (HP) | (Same as LNB Downconverted BSS RF (VP)) | | J6 (TNC) |
| | | LNB Band Select (HP) | (Same as LNB Band Select (VP)) | √ | |



3.3 Receive Antenna/Controller Interface

The receive antenna/controller interface signal characteristics are defined in Table 3.3-1. The controller to antenna clock, data, and error lines are Boeing part number S280W502-3.

TABLE 3.3-1 RECEIVE ANTENNA/CONTROLLER SIGNAL CHARACTERISTICS

| Receive Antenna (4390A2) Connector/ Pin Number | S | Signal Name | Signal Characteristics | S | Controller (4390A1) Connector/ Pin Number |
|--|---|----------------|--------------------------------|---|---|
| P2-5 | | Data 2 + | RS-422 | √ | J3-6 |
| P2-1 | | Data 2 - | | √ | J3-21 |
| P2-2 | - | Data 2 Shield | Data 2 + and Data 2 - Shield | - | J3-35 |
| P2-4 | | Clock 1 + | RS-422 | √ | J3-7 |
| P2-3 | | Clock 1 - | | √ | J3-22 |
| P2-2 | - | Clock 1 Shield | Clock 1 + and Clock 1 - Shield | - | J3-36 |
| P2-11 | | Data 0 + | RS-422 | √ | J3-3 |
| P2-23 | | Data 0 - | | √ | J3-18 |
| P2-22 | - | Data 0 Shield | Data 0 + and Data 0 - Shield | - | J3-32 |
| P2-12 | | Data 1 + | RS-422 | √ | J3-2 |
| P2-24 | | Data 1 - | | √ | J3-17 |
| P2-22 | - | Data 1 Shield | Data 1 + and Data 1 - Shield | - | J3-31 |
| P2-17 | | Clock 0 + | RS-422 | √ | J3-4 |
| P2-18 | | Clock 0 - | | √ | J3-19 |
| P2-19 | - | Clock 0 Shield | Clock 0 + and Clock 0 - Shield | - | J3-33 |
| P2-6 | √ | Error 0 + | RS-422 | | J3-15 |
| P2-7 | √ | Error 0 - | | | J3-30 |
| P2-19 | - | Error 0 Shield | Error 0 + and Error 0 - Shield | - | J3-44 |



3.4 Receive Antenna/Receive Power Supply Interface

The receive antenna/receive power supply interface signal characteristics are defined in Table 3.4-1.

TABLE 3.4-1 RECEIVE ANTENNA/RECEIVE POWER SUPPLY SIGNAL CHARACTERISTICS

| Receive Antenna (4390A2) Connector/ Pin Number | S | Signal Name | Signal Characteristics | S | Receive Power Supply (4390A3) Connector/ Pin Number |
|--|---|-------------------------|--|---|---|
| P1-4 | | Overtemperature Power | +5±0.5 Vdc, ≤ 3 mA (SK Only) +7.5±1.0 Vdc, < 15 mA (4 mA nominal) | √ | J3-4 |
| P1-1 | √ | Overtemperature Signal | Overtemperature: +5±0.5 Vdc, ≥ 100KΩ Not Overtemperature: ≤ 0.1 Vdc, ≤ 150Ω | | J3-1 |
| P1-2 | | Overtemperature Return | Return | √ | J3-2 |
| P1-3 | √ | +6/+5 Vdc Sense + | Voltage*: +5 ± 0.25 Vdc or +6 ± 0.25 Vdc | | J3-3 |
| P1-5 | √ | +6/+5 Vdc Sense - | Current: ≤ 1 mA | | J3-5 |
| P1-6 | | +6/+5 Vdc Select | Short between Select and Return = +6 Vdc** | | J3-6 |
| P1-7 | | +6/+5 Vdc Select Return | Open between Select and Return = +5 Vdc | | J3-7 |
| P1-A | | +6/+5 Vdc | Voltage*: +5 ± 0.25 Vdc or +6 ± 0.25 Vdc Current: 29 to 83 A | √ | J3-A |
| P1-B | - | +6/+5 Vdc Return | Return | - | J3-B |
| P1-C | | - 5 Vdc | Voltage: - 5 +5/-10% Vdc Current: 0.47 to 1.6 A | √ | J3-C |
| P1-D | - | - 5 Vdc Return | Return | - | J3-D |

*The receive power supply will provide +6 Vdc (instead of +5 Vdc) when a jumper is installed per Table 3.4-1.

**Note that the short or open of the +6 / +5 Vdc Select and Return lines is implemented in the receive antenna (anywhere between connector P1 and the antenna proper).



3.5 Receive Power Supply/Controller Interface

The receive power supply/controller interface signal characteristics are defined in Table 3.5-1.

TABLE 3.5-1 RECEIVE POWER SUPPLY/CONTROLLER SIGNAL CHARACTERISTICS

| Receive Power Supply (4390A3) Connector/ Pin Number | S | Signal Name | Signal Characteristics | S | Controller (4390A2) Connector/ Pin Number |
|---|---|--------------------------|--|---|---|
| J1-16 | √ | + 19.5 Vdc Line 1 | Voltage: +19.5±2.0 Vdc Current: 0.53 to 0.88 A (Total for both lines) | | J1-1 |
| J1-17 | — | + 19.5 Vdc Line 1 Return | Return | — | J1-2 |
| J1-18 | √ | + 19.5 Vdc Line 2 | (Same as + 19.5 Vdc Line 1) | | J1-9 |
| J1-19 | — | + 19.5 Vdc Line 2 Return | Return | — | J1-10 |
| J1-9 | √ | Status 0 + (LSB) | +5V Differential, 2 Bit Code + to - : +5V = 1, -5V = 0 | | J1-4 |
| J1-8 | √ | Status 0 - (LSB) | Status codes, as Binary-Coded Decimal (BCD) (Status 0 is Least Significant Bit (LSB), Status 1 is Most Significant Bit (MSB)): | | J1-5 |
| J1-10 | √ | Status 1 + (MSB) | <u>Decimal</u> <u>BCD</u> <u>Status</u> 0 00 Antenna Overtemperature 1 01 Controller/LNB Power Fault | | J1-11 |
| J1-11 | √ | Status 1 - (MSB) | 2 10 Antenna Power Fault 3 11 No Faults | | J1-12 |
| | — | Chassis Ground | Ground | — | J1-13 |

3.6 Receive Power Supply/LNB Interface

The receive power supply/LNB interface signal characteristics are defined in Table 3.6-1.

TABLE 3.6-1 RECEIVE POWER SUPPLY/LNB SIGNAL CHARACTERISTICS

| Receive Power Supply (4390A3) Connector/ Pin Number | S | Signal Name | Signal Characteristics | S | LNB (4390A4) Connector/ Pin Number |
|---|---|-------------------|---|---|------------------------------------|
| J1-20 | √ | + 19.5 Vdc (LNB) | Voltage: +19.5±2.0 Vdc Current: 0.4 to 1.250 A | | J3-1 |
| J1-21 | — | + 19.5 Vdc Return | Return | — | J3-2 |
| | — | Chassis Ground | Ground (For LNB Test Only) | — | J3-3 |
| J1-BS | — | + 19.5 Vdc Shield | Shield | — | J3-BS |



- 3.7 Reserved
- 3.8 Reserved
- 3.9 Reserved
- 3.10 Reserved
- 3.11 LPC/LNB Interface

The LPC/LNB interface signal characteristics are defined in Table 3.11-1.

TABLE 3.11-1 LPC/LNB SIGNAL CHARACTERISTICS

| LPC (4390A36) Connector | S | Signal Name | Signal Characteristics | S | LNB (4390A4) Connector/ Pin Number |
|-------------------------------|---|-------------|---|---|---|
| J3 (SMA) | √ | BSS RF (VP) | RF Frequency Range: 11.7 to 12.7 GHz Signal Level: per figure 3-2 RF Impedance: 50 Ω | | J1-1 (SMA) |
| J4 (SMA) | √ | BSS RF (HP) | (Same as BSS RF (VP)) | | J1-2 (SMA) |

VP and HP cables are identical length (+/- 5 millimeter). Total length is 18" \pm 1".



4. EXTERNAL INTERFACES

The signal characteristics for each of the external interface connections are contained in the sections identified on Figure 4-1.

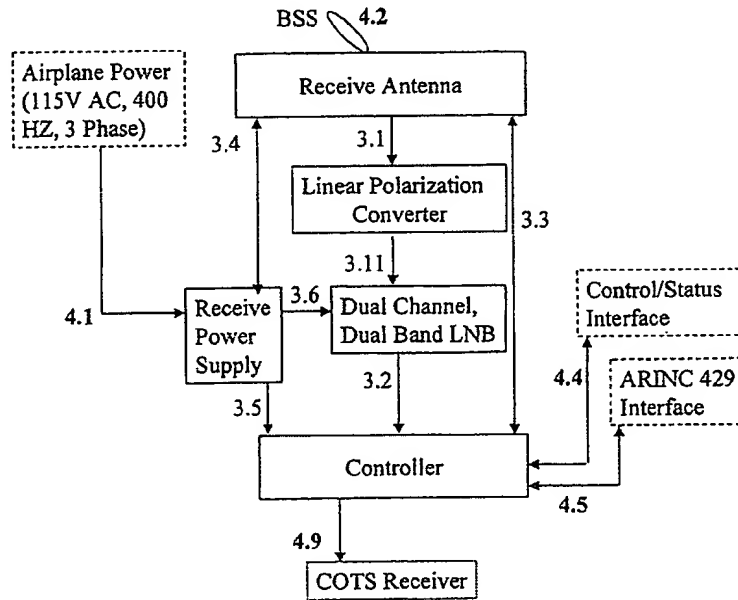


FIGURE 4-1 EXTERNAL INTERFACE SECTIONS



4.1 Airplane Power (115V AC, 400 Hz) Interface

The airplane power (115V AC, 400 Hz) interface signal characteristics are defined in Table 4.1-1.

TABLE 4.1-1 AIRPLANE POWER SIGNAL CHARACTERISTICS

| Power Supply (4390A3) Connector/ Pin Number | S | Signal Name | Signal Characteristics | S | Airplane Connector/ Pin Number |
|--|---|----------------|--|---|--------------------------------------|
| J2-1 | | Phase A | 115V AC, 400 Hz | √ | P2-1 |
| J2-3 | | Phase B | 115V AC, 400 Hz (120 degree phase displacement from Phase A) | √ | P2-3 |
| J2-5 | | Phase C | 115V AC, 400 Hz (240 degree phase displacement from Phase A) | √ | P2-5 |
| J2-7 | – | Neutral | Return | – | P2-7 |
| J2-6 | – | Chassis Ground | Safety Ground | – | P2-6 |

4.2 Broadcast Satellite Services Interface

The broadcast satellite services interface signal characteristics are defined in Table 4.2-1.

TABLE 4.2-1 BROADCAST SATELLITE SERVICES SIGNAL CHARACTERISTICS

| BSS Satellite | S | Signal Name | Signal Characteristics | S | Receive Antenna (4390A2) |
|---------------------------------|---|-------------|---|---|--------------------------------|
| Downlink Transmit Antenna | √ | BSS Input | Electromagnetic Wave Frequency Range: 11.7 to 12.7 GHz Instantaneous Bandwidth: 500 MHz Flux: see figure 3-2[Flux(dBW/m ²) =EIRP(dBW) - 20log(Path (km)) - 71.0, where "Path" is satellite-antenna distance.] Polarization: Horizontal and Vertical | | Phased Array |



4.3 Reserved

4.4 Control/Status Interface

The control/status interface signal characteristics are defined in Table 4.4-1.

TABLE 4.4-1 CONTROL/STATUS INTERFACE SIGNAL CHARACTERISTICS

| Controller (4390A1) Connector/ Pin Number | S | Signal Name | Signal Characteristics | S | Connector/ Pin Number |
|--|---|---------------------------------|---|---|--------------------------|
| J2-4 | | Control/Status RX | RS-232, asynchronous 8 data bits, 1 start bit, 1 stop bit, no parity 19200 baud | √ | P2-4 |
| J2-5 | √ | Control/Status TX | (Same as Control/Status RX) | | P2-5 |
| J2-12 | – | Control/Status Signal Return | Return | – | P2-12 |
| J2-13 | – | Control/Status Signal Shield | Shield | – | P2-13 |
| J2-6 | | Shop Mode 0 | TTL Levels (inputs to controller) | | P2-6 |
| J2-14 | | Shop Mode 1 | Open = 0, Ground = 1 | | P2-14 |
| J2-1 | √ | Shop Mode RX | (Same as Control/Status RX) | | P2-1 |
| J2-2 | | Shop Mode TX | (Same as Control/Status RX) | √ | P2-2 |
| J2-9 | – | Shop Mode Return | Return | – | P2-9 |
| J2-8 | √ | 485 Port 2 + (Spare) | RS-485 | | Not Connected |
| J2-7 | √ | 485 Port 2 - (Spare) | | | Not Connected |
| J2-15 | – | 485 Port 2 Shield (Spare) | 485 Port 2 + and 485 Port 2 - Shield | – | Not Connected |

4.5 ARINC 429 Interface

The ARINC 429 interface signal characteristics are defined in Table 4.5-1.

TABLE 4.5-1 ARINC 429 SIGNAL CHARACTERISTICS

| Controller (4390A1) Connector/ Pin Number | S | Signal Name | Signal Characteristics | S | Connector/ Pin Number |
|--|---|------------------|---|---|--------------------------|
| J4-2 | | ARINC 429 RX A | High = +6.5 to +13.0 VDC differential Low = -6.5 to -13.0 VDC differential Null = -2.5 to +2.5 VDC differential | √ | P4-2 |
| J4-3 | | ARINC 429 RX B | | √ | P4-3 |
| J4-7 | – | ARINC 429 Shield | Shield | – | P4-7 |



- 4.6 Reserved
- 4.7 Reserved
- 4.8 Reserved
- 4.9 COTS Receiver

The Controller/COTS Receiver interface signal characteristics are defined in Table 4.8-1.

TABLE 4.8-1 CONTROLLER/COTS RECEIVER SIGNAL CHARACTERISTICS

| Controller (4390A1) Connector/ Pin Number | S | Signal Name | Signal Characteristics | S | COTS Receiver Connector / Pin Number |
|--|---|------------------------------|--|---|--|
| J8 (TNC) | √ | Downconverted BSS RF (VP) | Frequency Range: 950 to 1450 MHz Signal Level: per figure 3-2 $E_b/N_0 \geq 5.8$ dB Line Impedance: 50 Ω | | Per Receiver |
| J7 (TNC) | √ | Downconverted BSS RF (HP) | (Same as Downconverted BSS RF (VP)) | | Not connected |



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